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(54) **Thermal dye transfer printer having lamination area determined by image data**

(57) The area of laminate transferred to overlie an image on a receiver medium is determined from image data (100,Fig.15) evaluated by the printer to calculate image boundaries (step 102), and from these, the laminate boundaries (step 104). An image is then printed (step 106) and laminated (step 108). A printer is also disclosed that forms an image 10 (Fig.6a) within a maximum image area 14 on a receiver medium 12 that can be laminated so that the area of laminate 20 transferred is different to the image area.

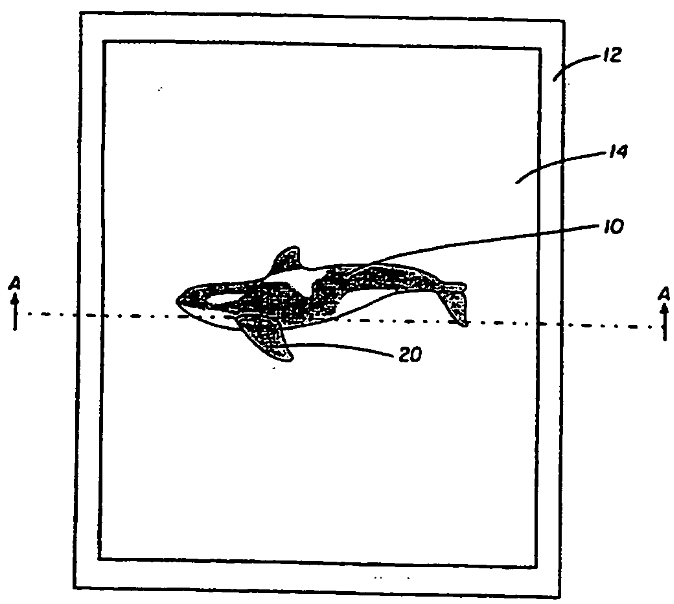
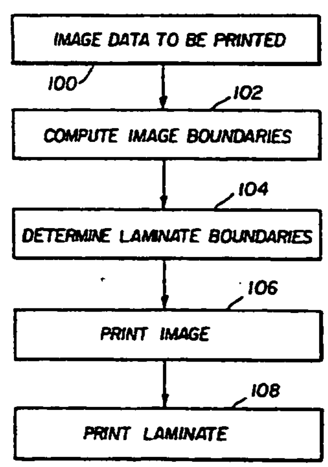


FIG. 6a

FIG. 15



GB 2 317 367 A

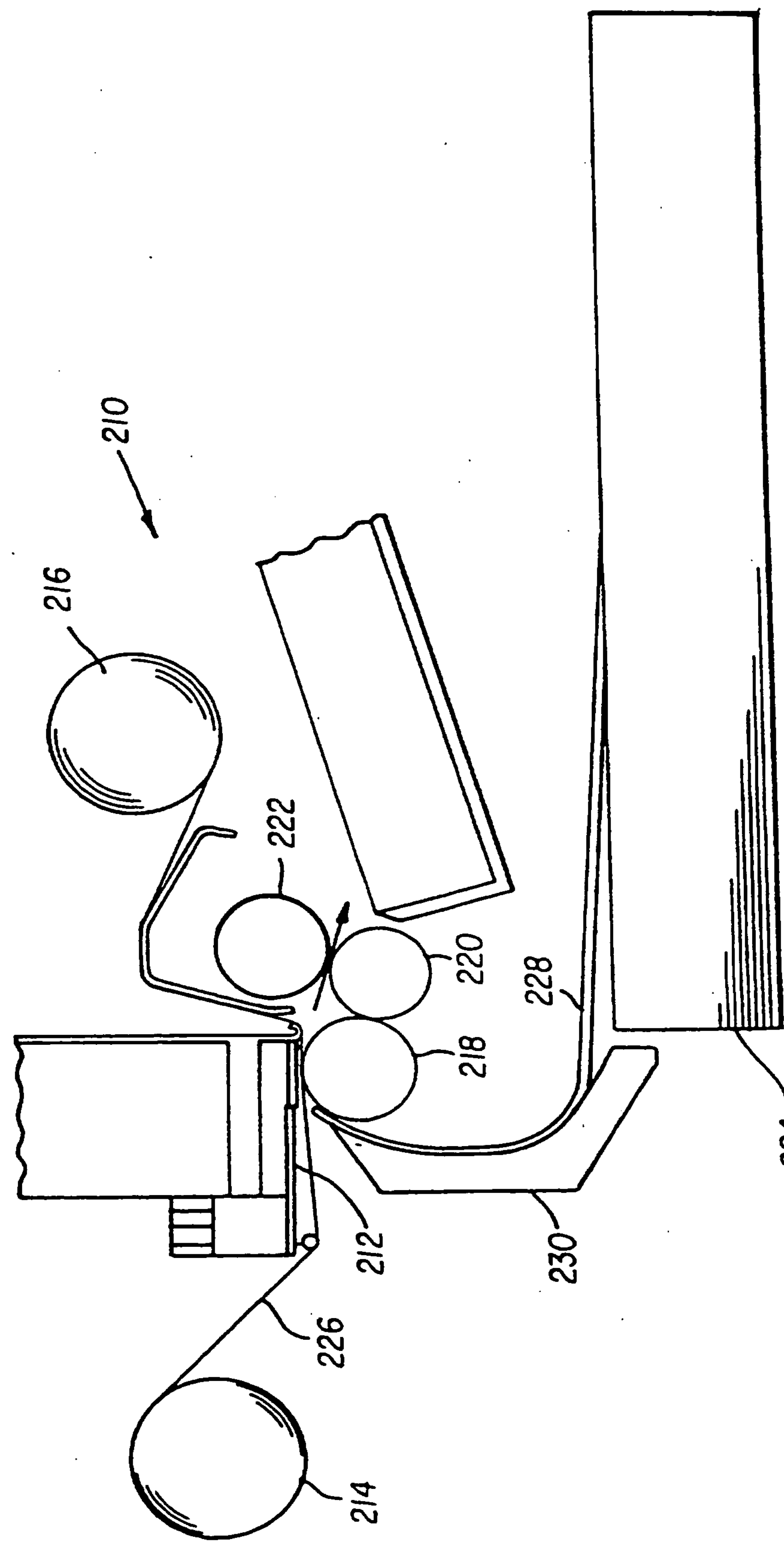


FIG. 1

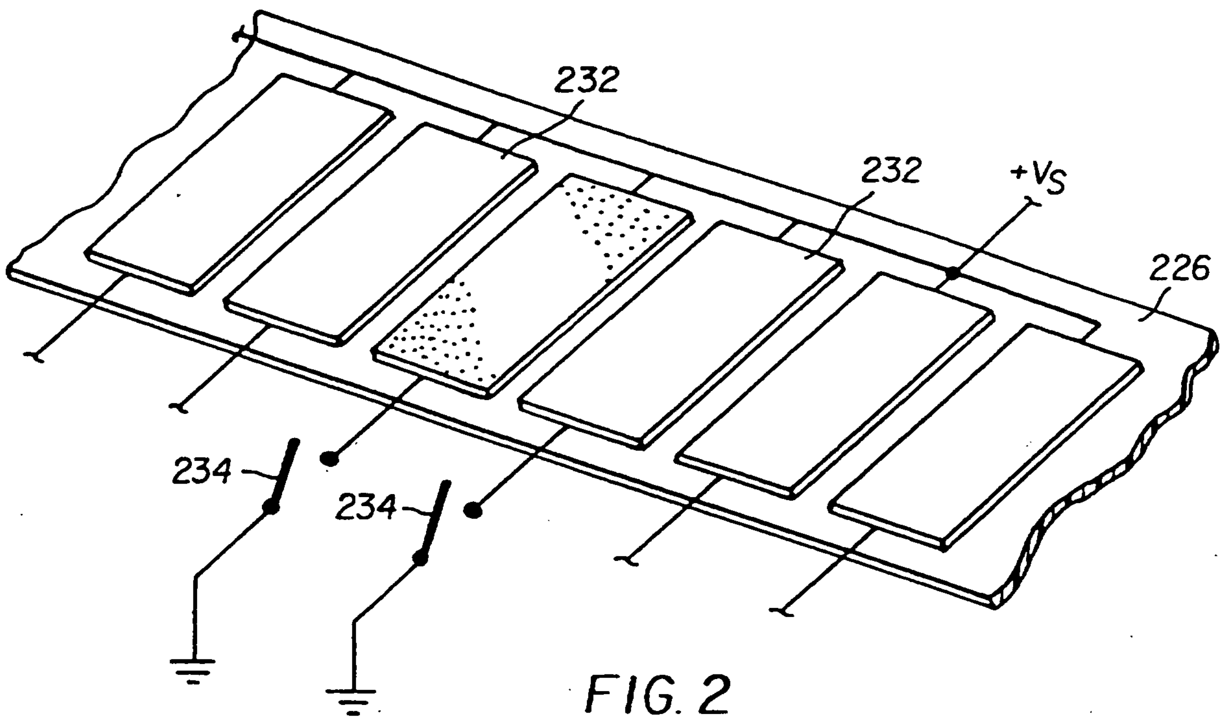

232
232
+VS
226
234
234

FIG. 2

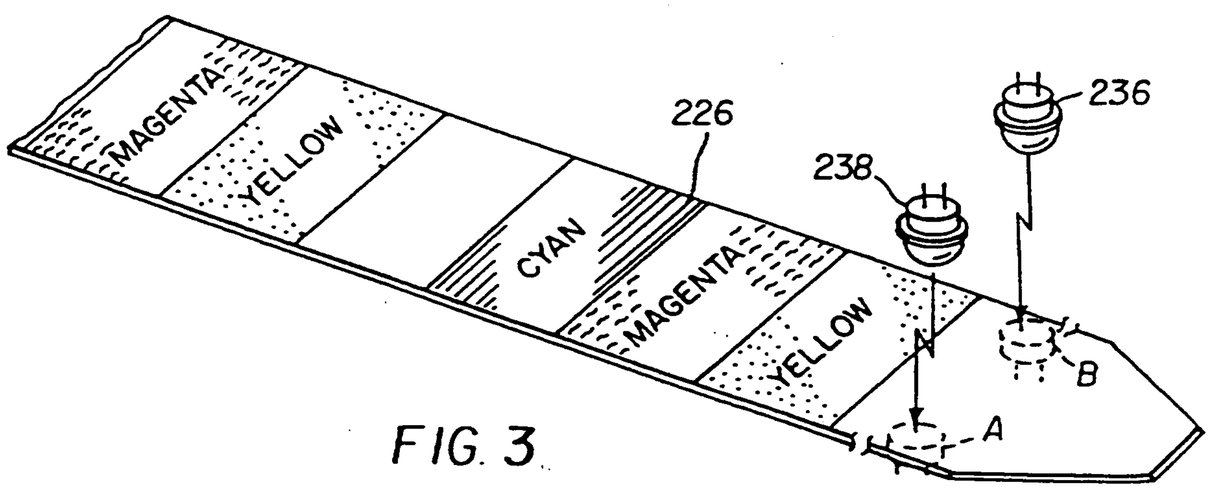

MAGENTA
YELLOW
226
CYAN
MAGENTA
YELLOW
238
236
A
B

FIG. 3

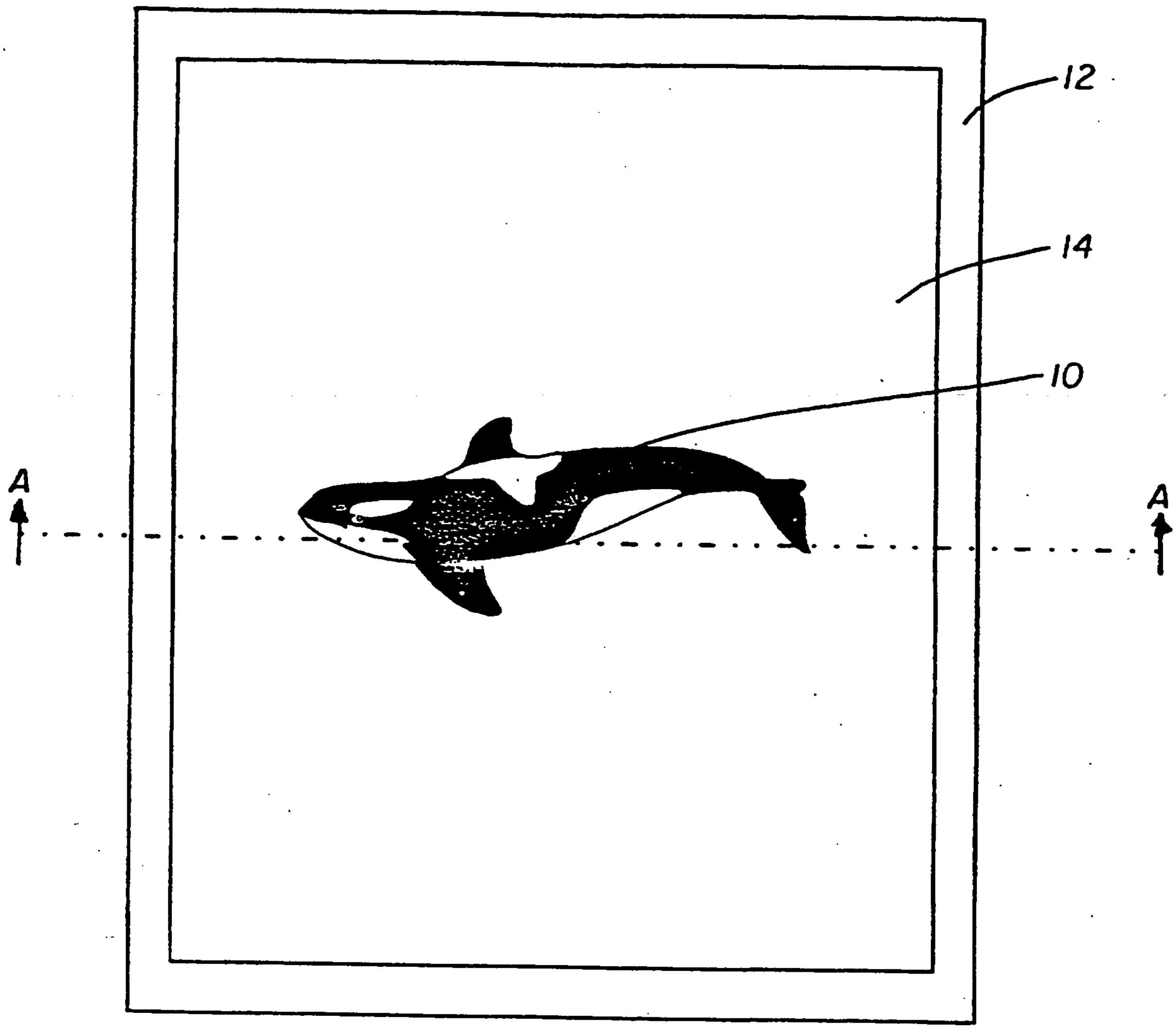


FIG. 4a

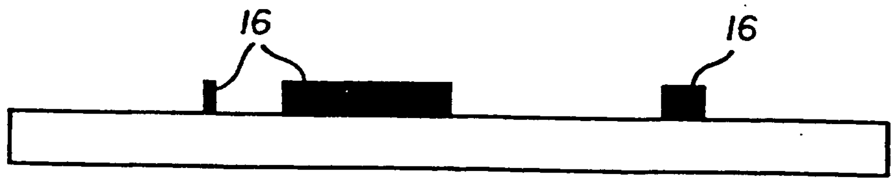


FIG. 4b

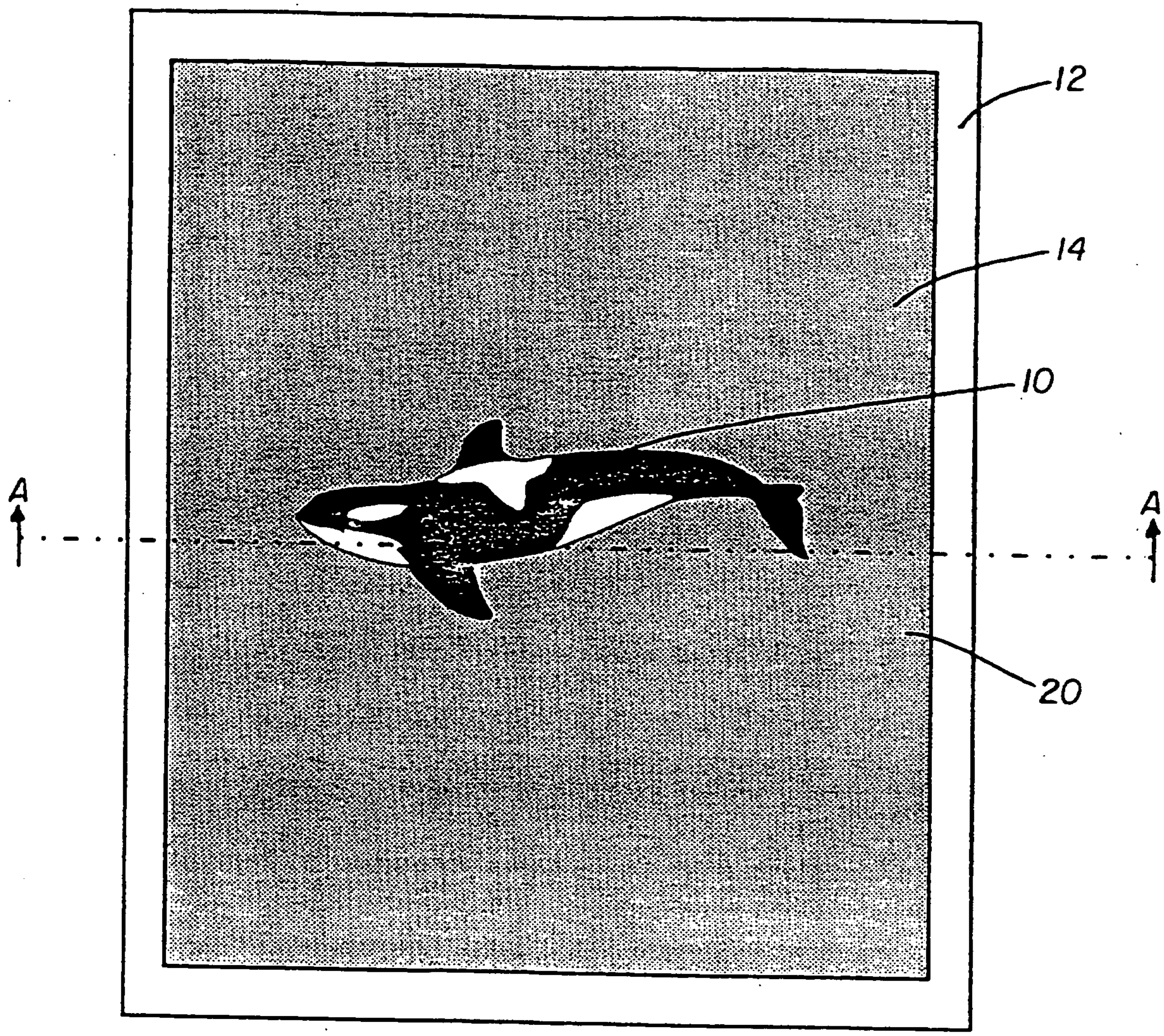


FIG. 5a
(prior art)

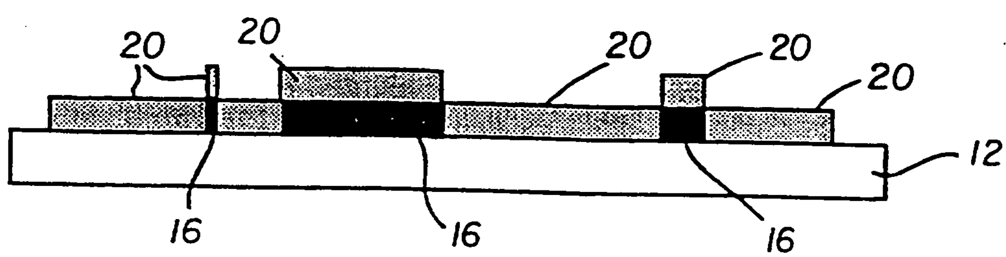


FIG. 5b
(prior art)

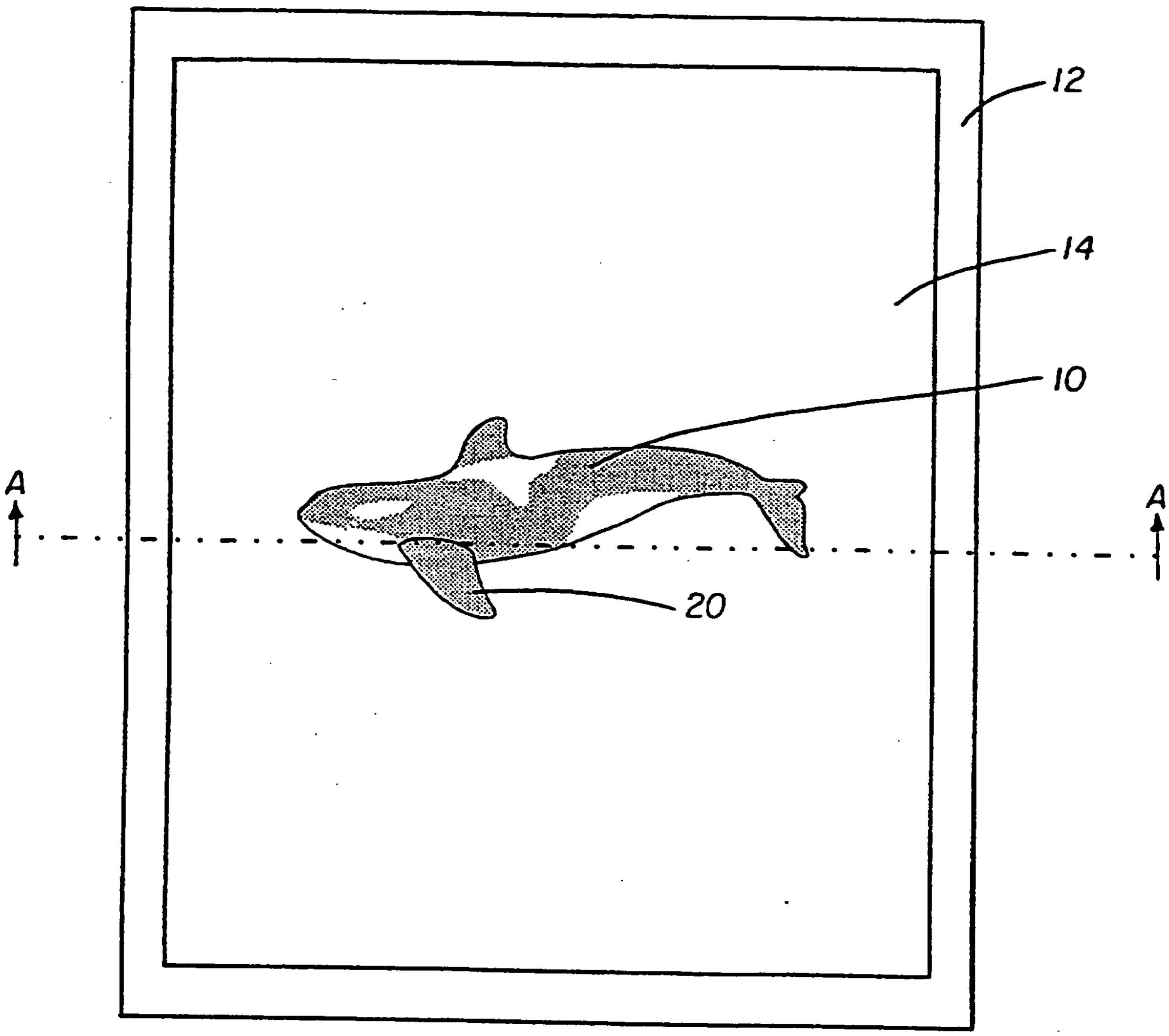


FIG. 6a

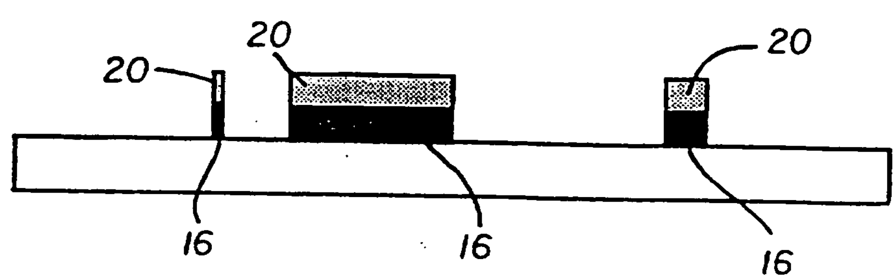


FIG. 6b

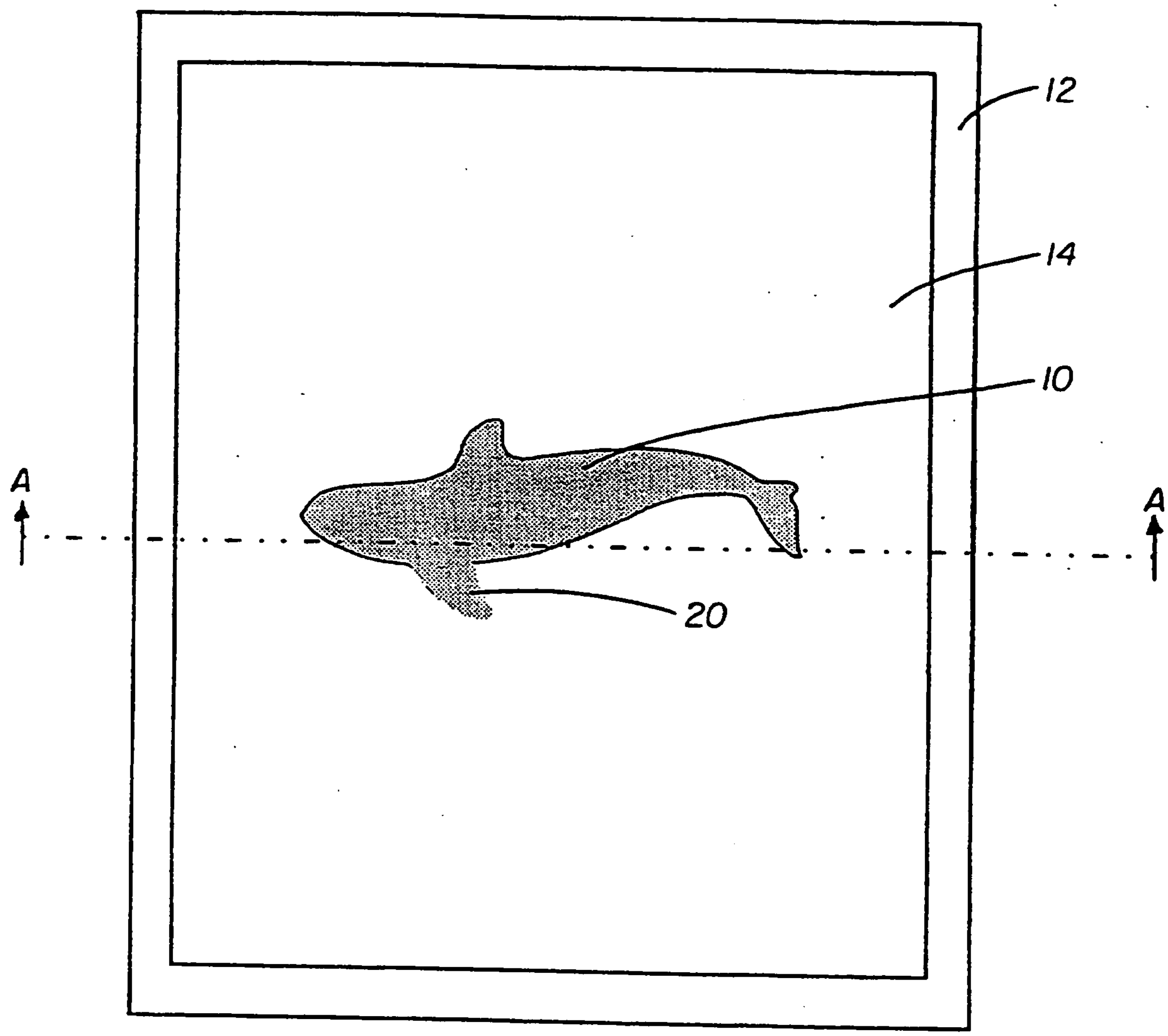
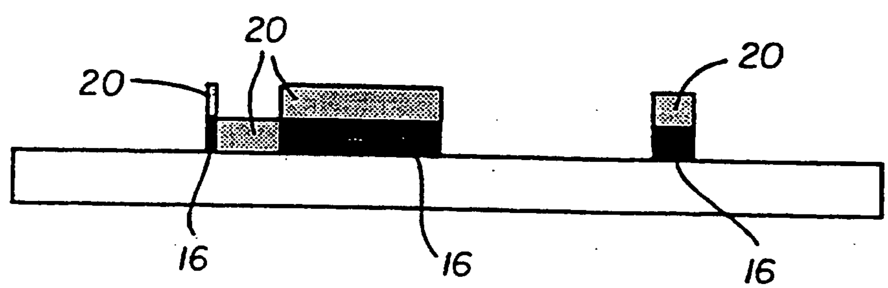


FIG. 7a



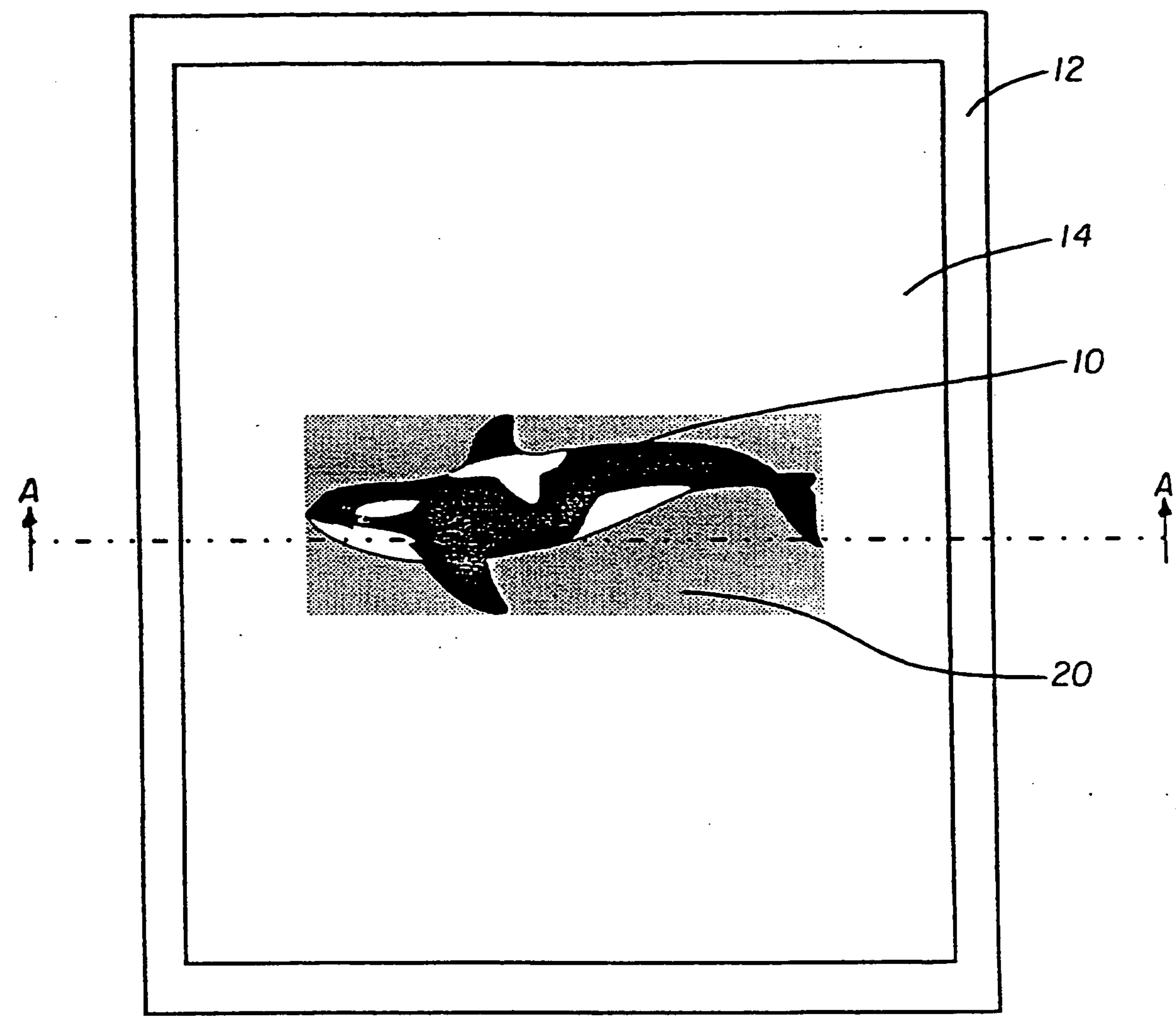


FIG. 8a

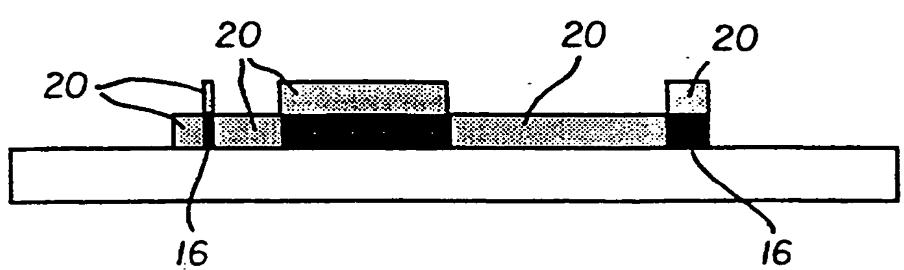


FIG. 8b

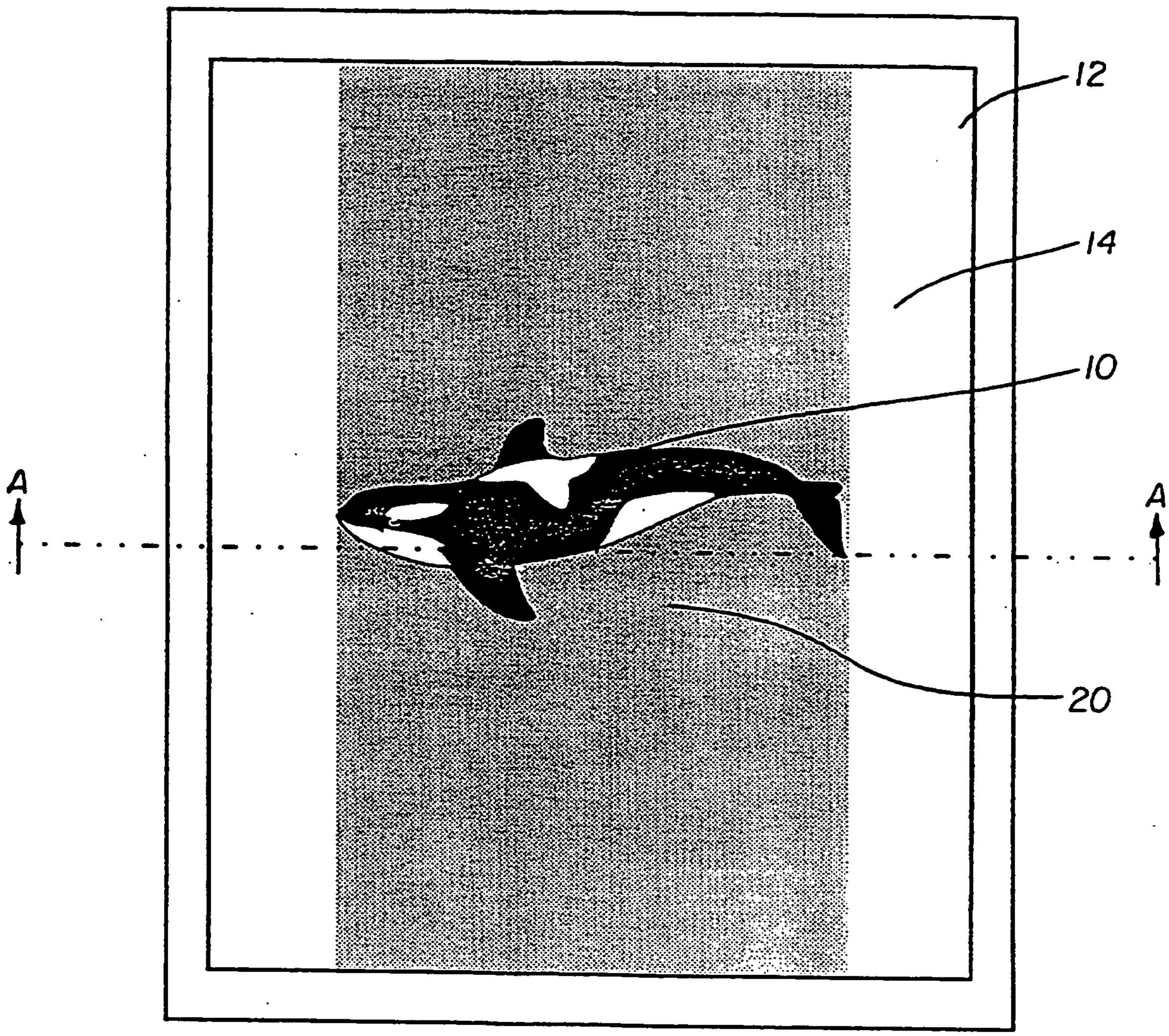


FIG. 9a

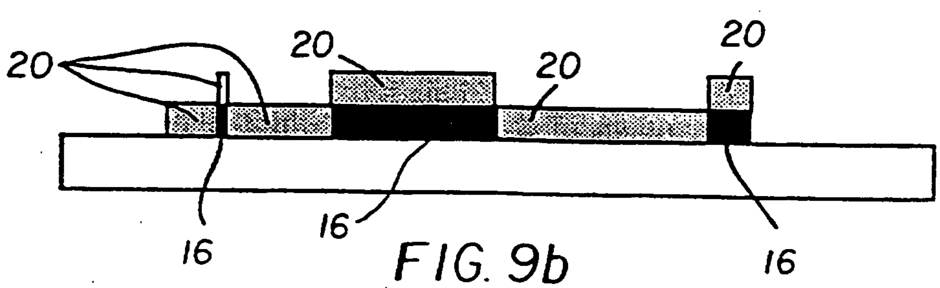


FIG. 9b

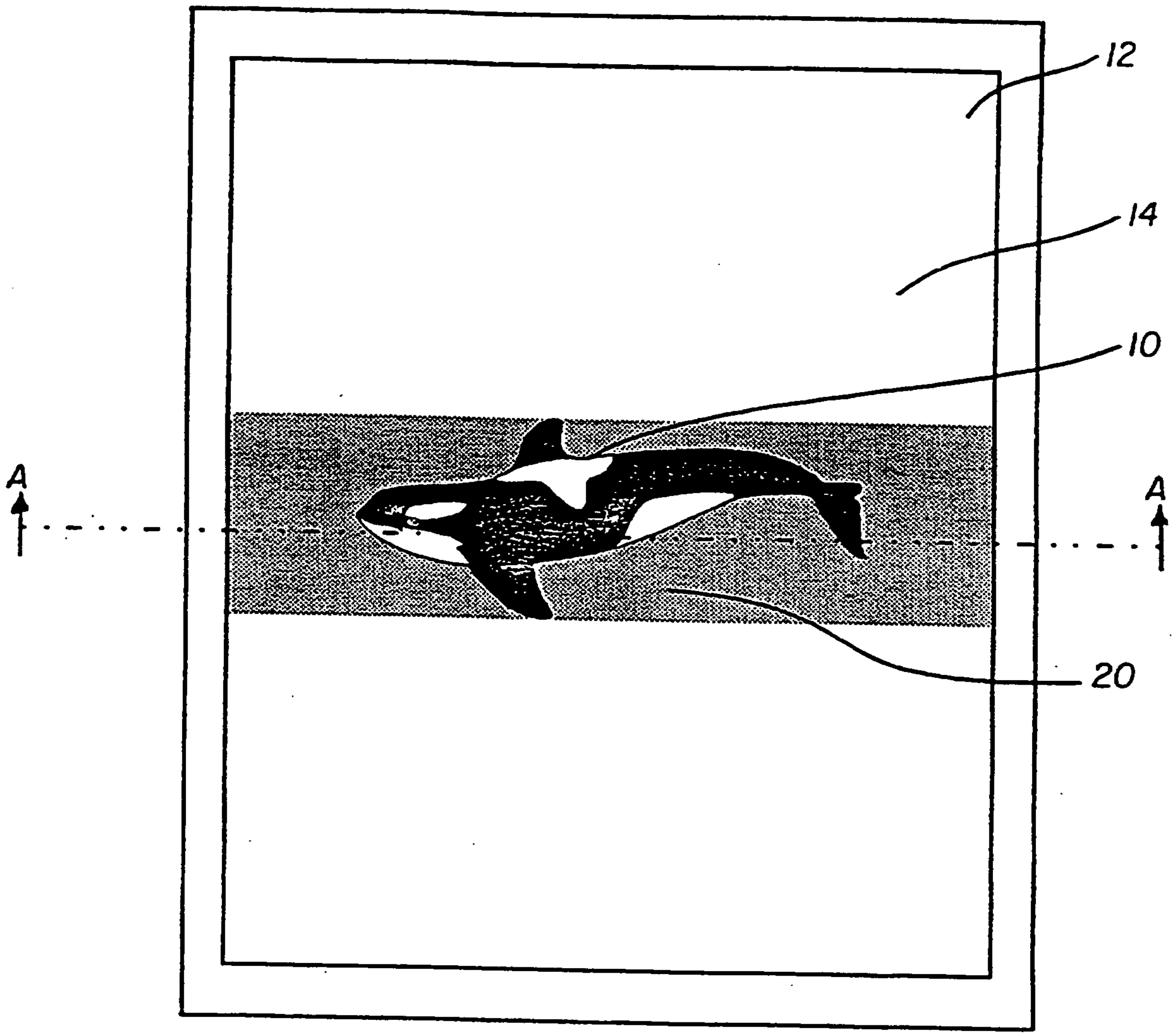


FIG. 10a

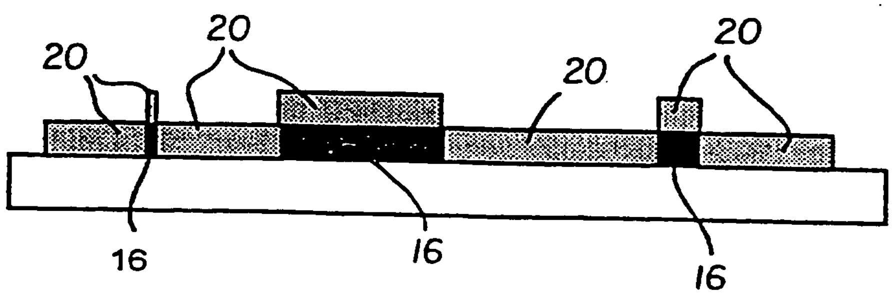


FIG. 10b

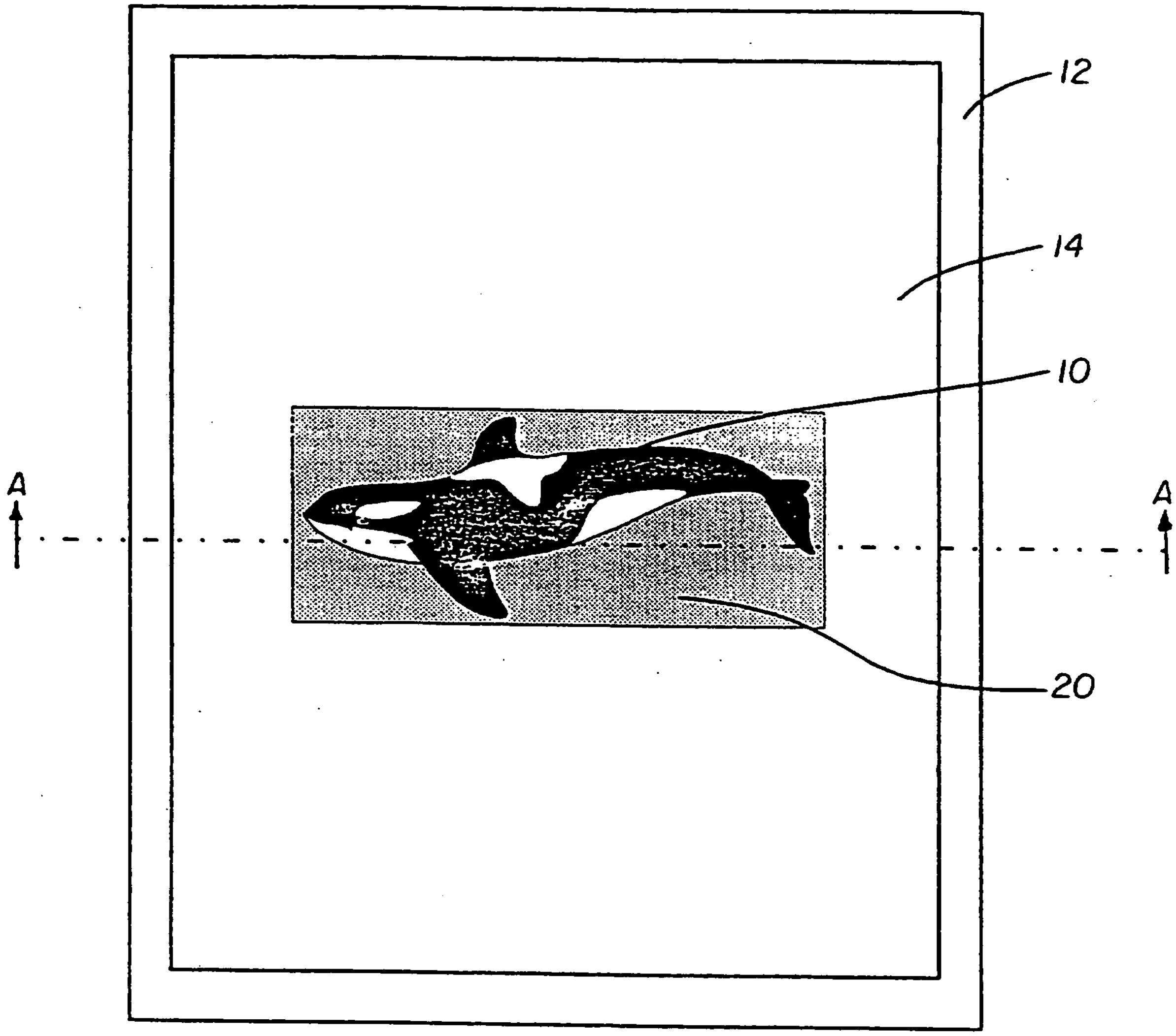


FIG. 11a

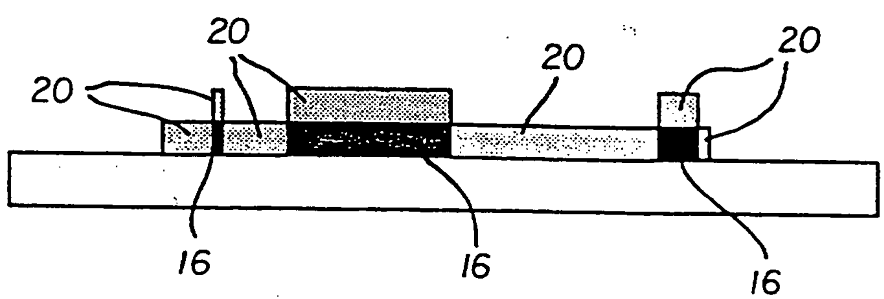


FIG. 11b

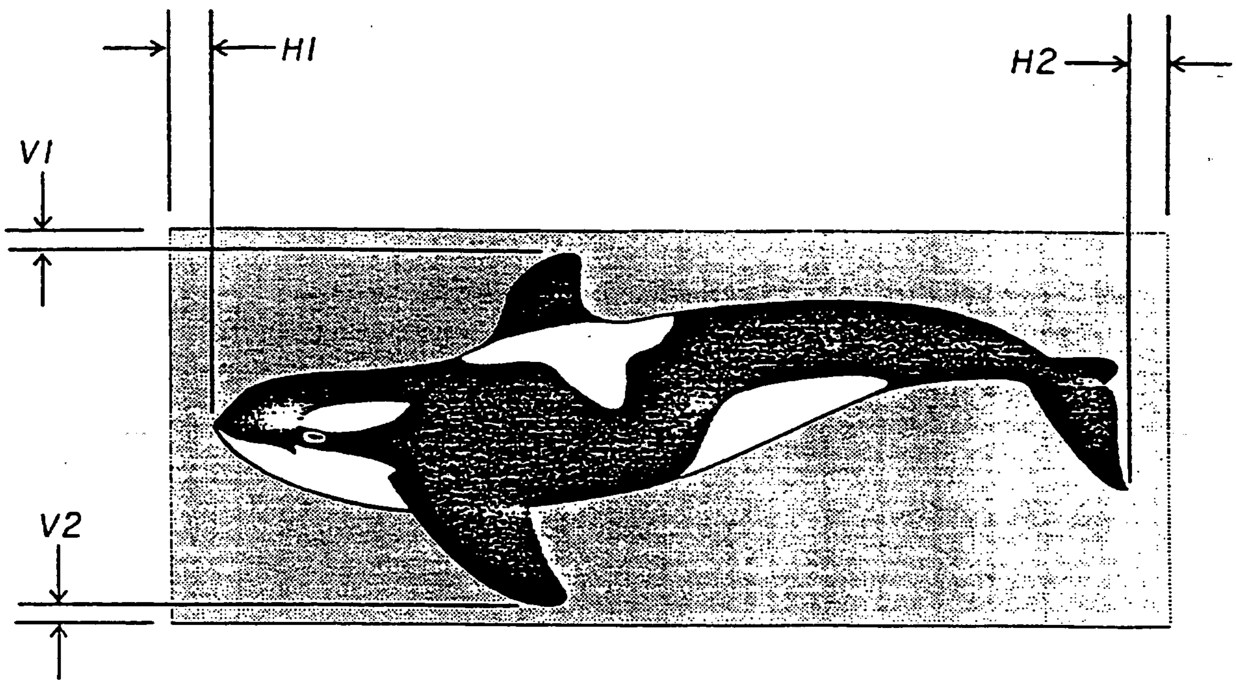


FIG. 12

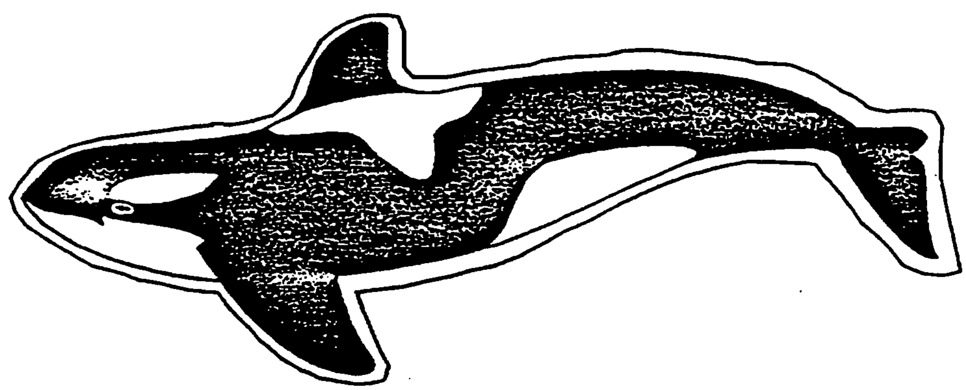


FIG. 13

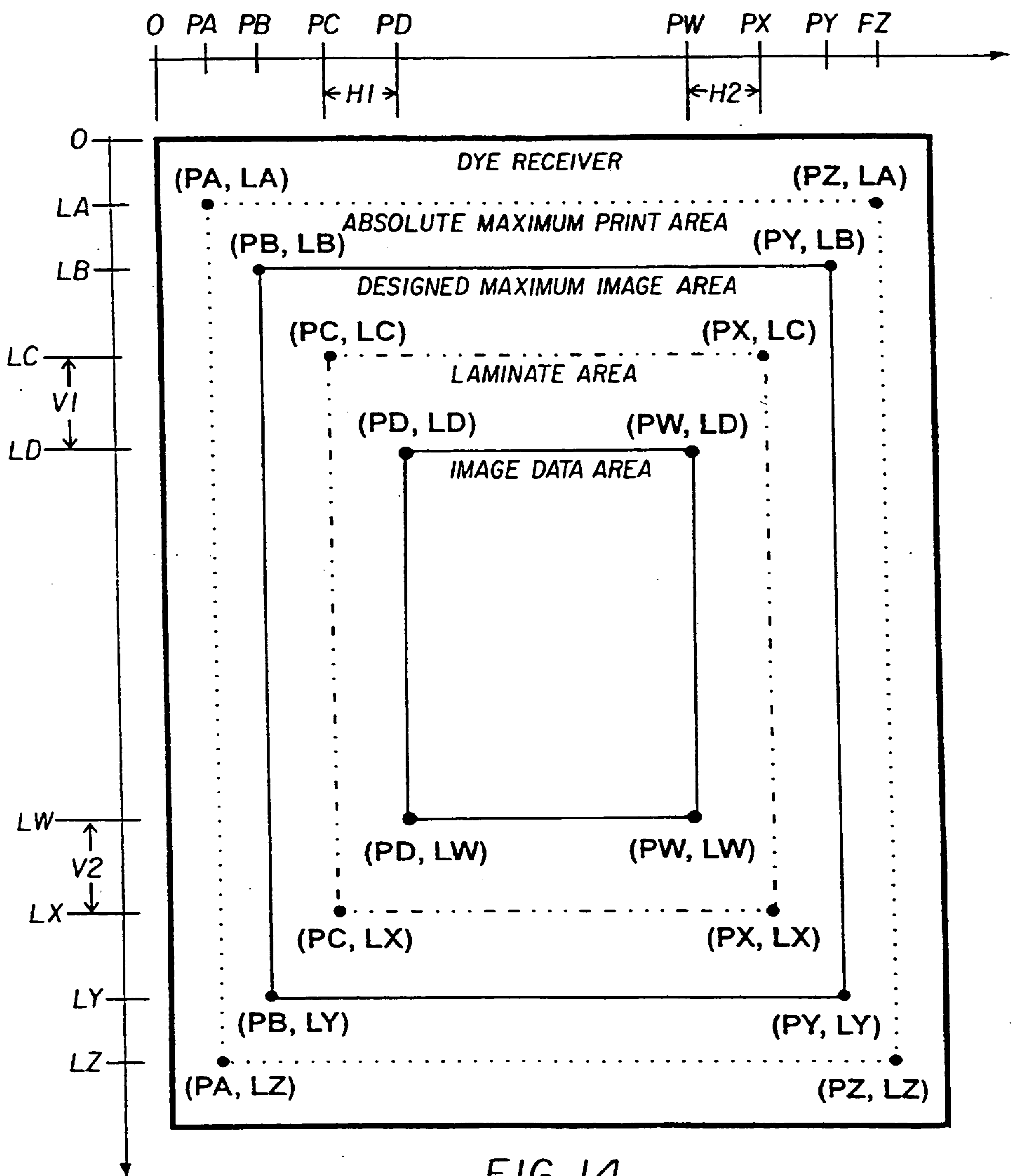

0 PA PB PC PD PW PX PY FZ
H1
H2
0
LA
LB
LC
V1
LD
LW
V2
LX
LY
LZ
DYE RECEIVER
(PA, LA)
(PZ, LA)
ABSOLUTE MAXIMUM PRINT AREA
(PB, LB)
(PY, LB)
DESIGNED MAXIMUM IMAGE AREA
(PC, LC)
(PX, LC)
LAMINATE AREA
(PD, LD)
(PW, LD)
IMAGE DATA AREA
(PD, LW)
(PW, LW)
(PC, LX)
(PX, LX)
(PB, LY)
(PY, LY)
(PA, LZ)
(PZ, LZ)

FIG. 14

FIG. 15

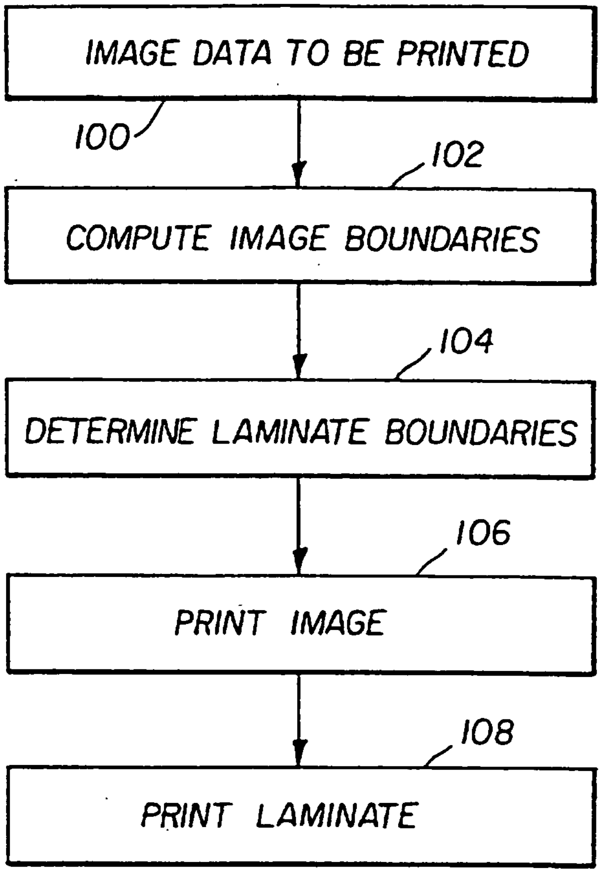
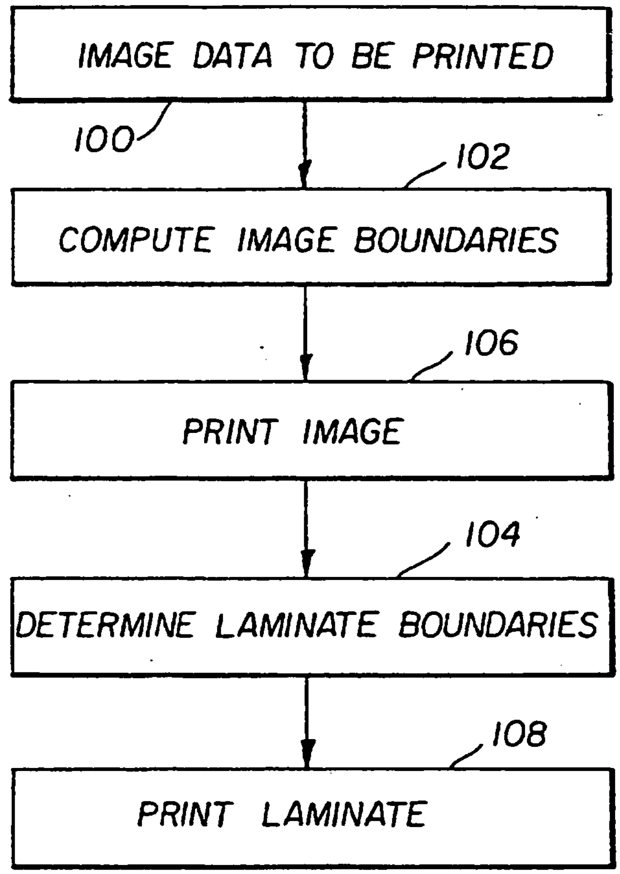


FIG. 16



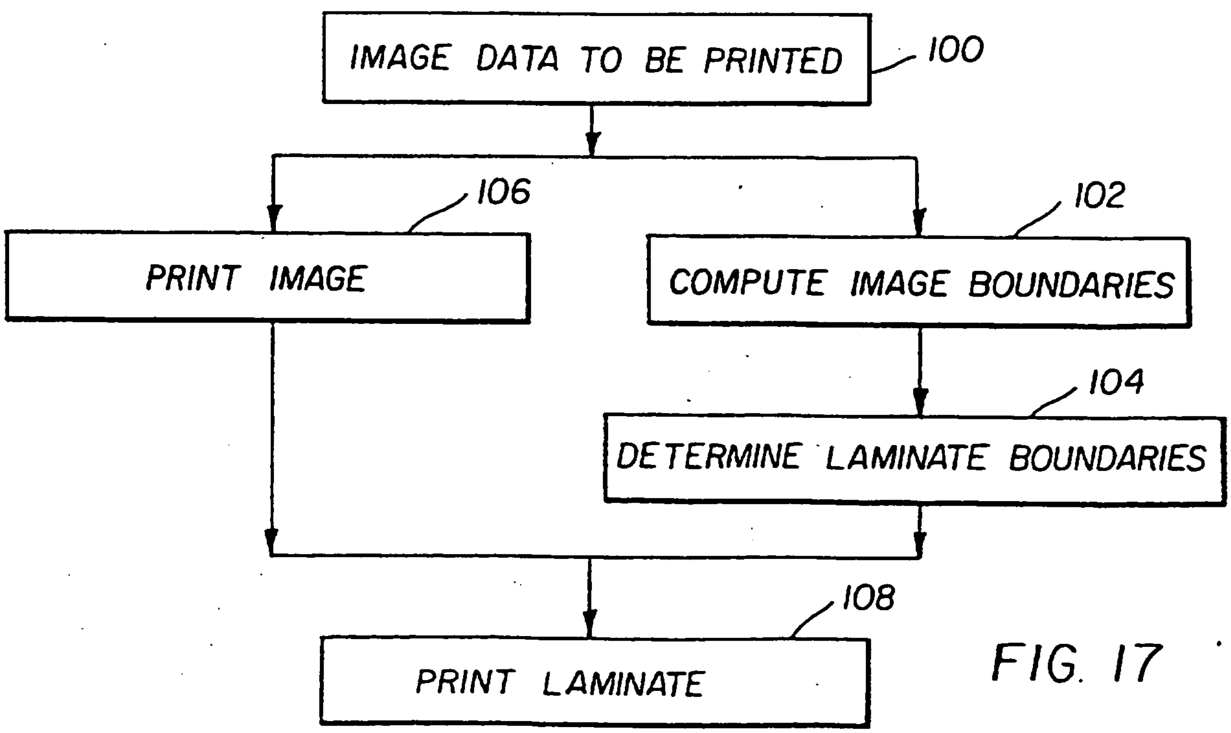
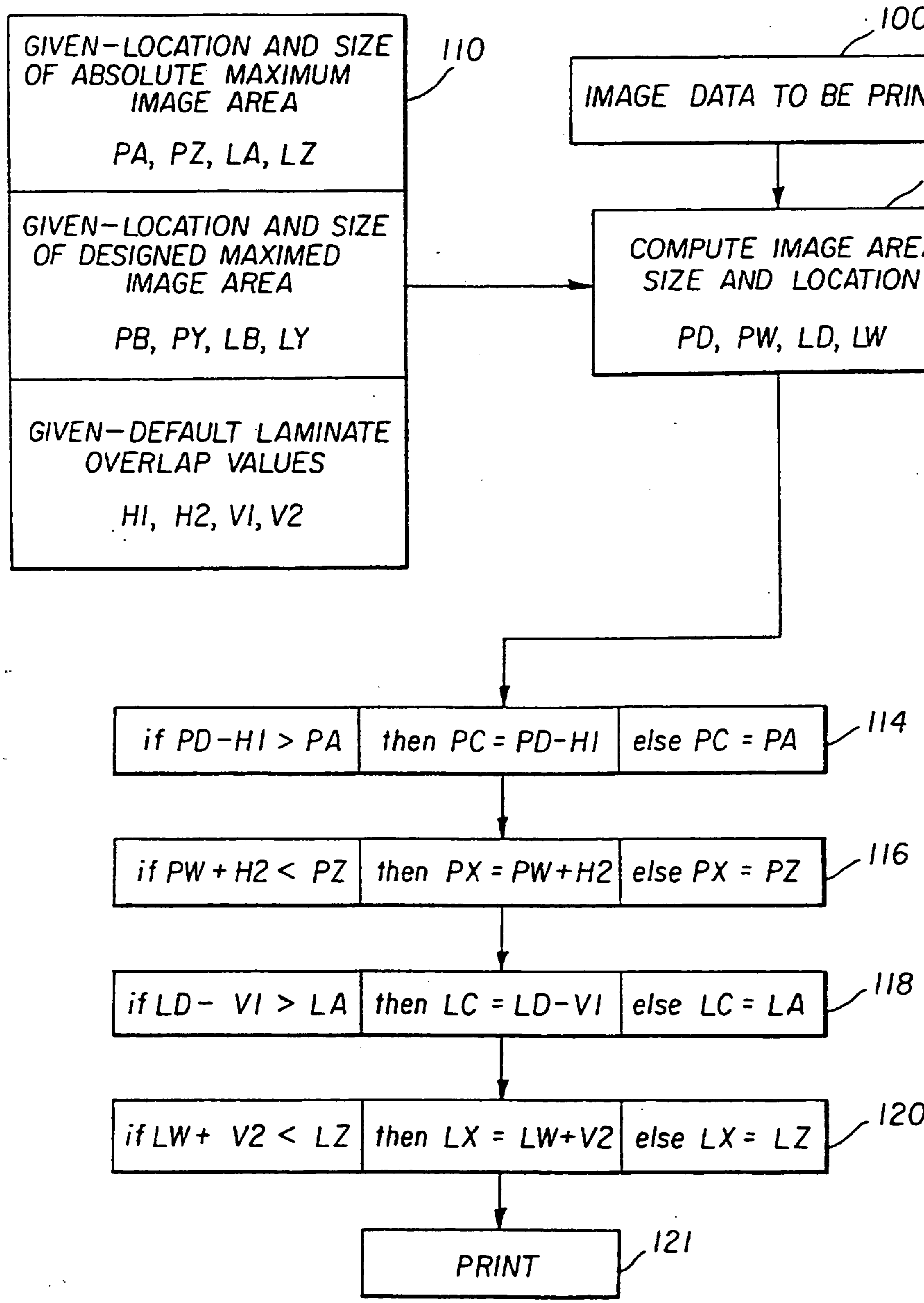
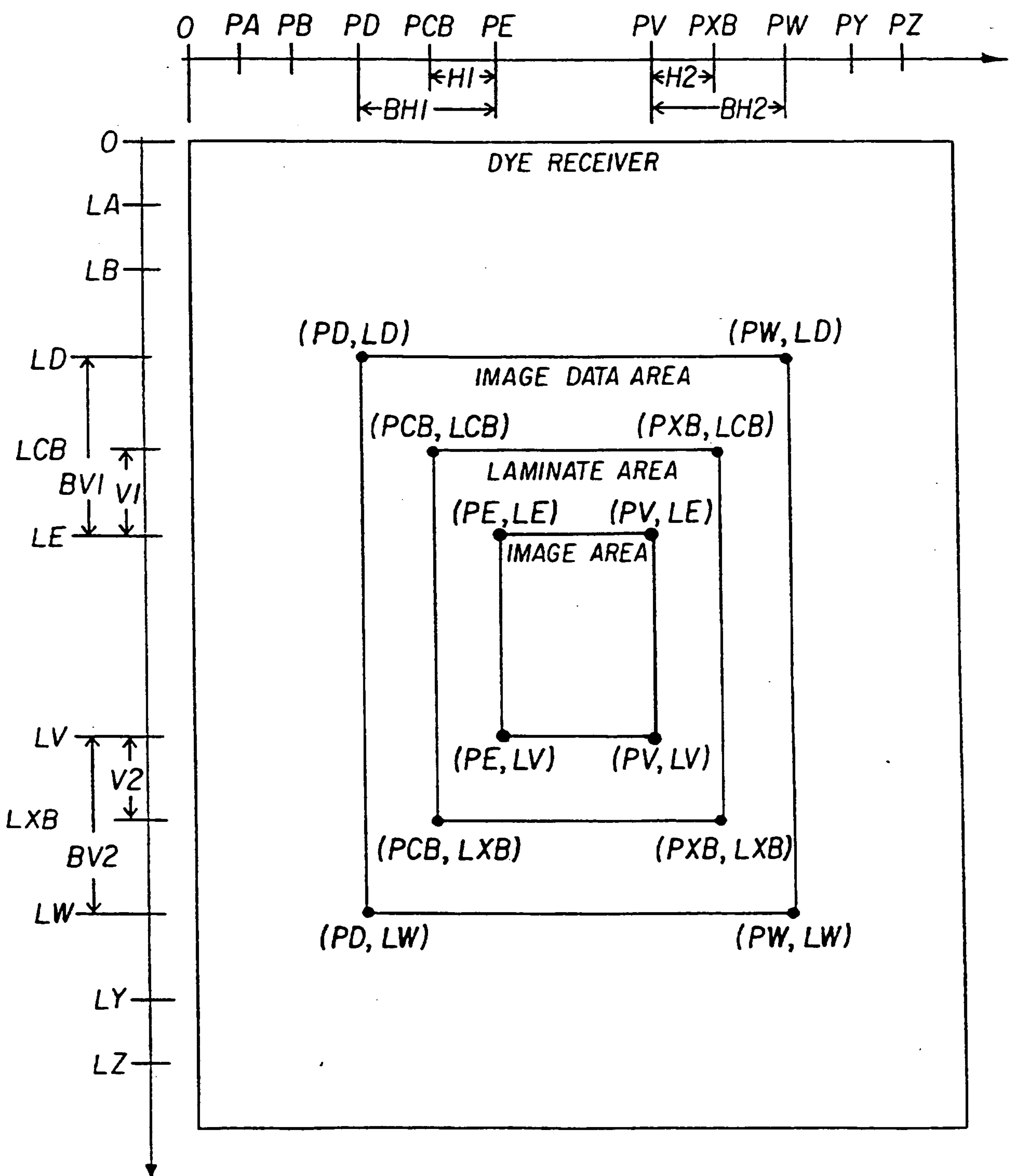


FIG. 17



GIVEN-LOCATION AND SIZE OF ABSOLUTE MAXIMUM IMAGE AREA
PA, PZ, LA, LZ
GIVEN-LOCATION AND SIZE OF DESIGNED MAXIMED IMAGE AREA
PB, PY, LB, LY
GIVEN-DEFAULT LAMINATE OVERLAP VALUES
H1, H2, V1, V2
110
100
IMAGE DATA TO BE PRINTED
112
COMPUTE IMAGE AREA SIZE AND LOCATION
PD, PW, LD, LW
if PD-H1 > PA
then PC = PD-H1
else PC = PA
114
if PW + H2 < PZ
then PX = PW+H2
else PX = PZ
116
if LD- V1 > LA
then LC = LD-V1
else LC = LA
118
if LW+ V2 < LZ
then LX = LW+V2
else LX = LZ
120
PRINT
121

FIG. 18



O
PA
PB
PD
PCB
PE
PV
PXB
PW
PY
PZ
H1
H2
BH1
BH2
O
LA
LB
LD
LCB
BV1
V1
LE
LV
V2
LXB
BV2
LW
LY
LZ
DYE RECEIVER
(PD, LD)
(PW, LD)
IMAGE DATA AREA
(PCB, LCB)
(PXB, LCB)
LAMINATE AREA
(PE, LE)
(PV, LE)
IMAGE AREA
(PE, LV)
(PV, LV)
(PCB, LXB)
(PXB, LXB)
(PD, LW)
(PW, LW)

FIG. 19

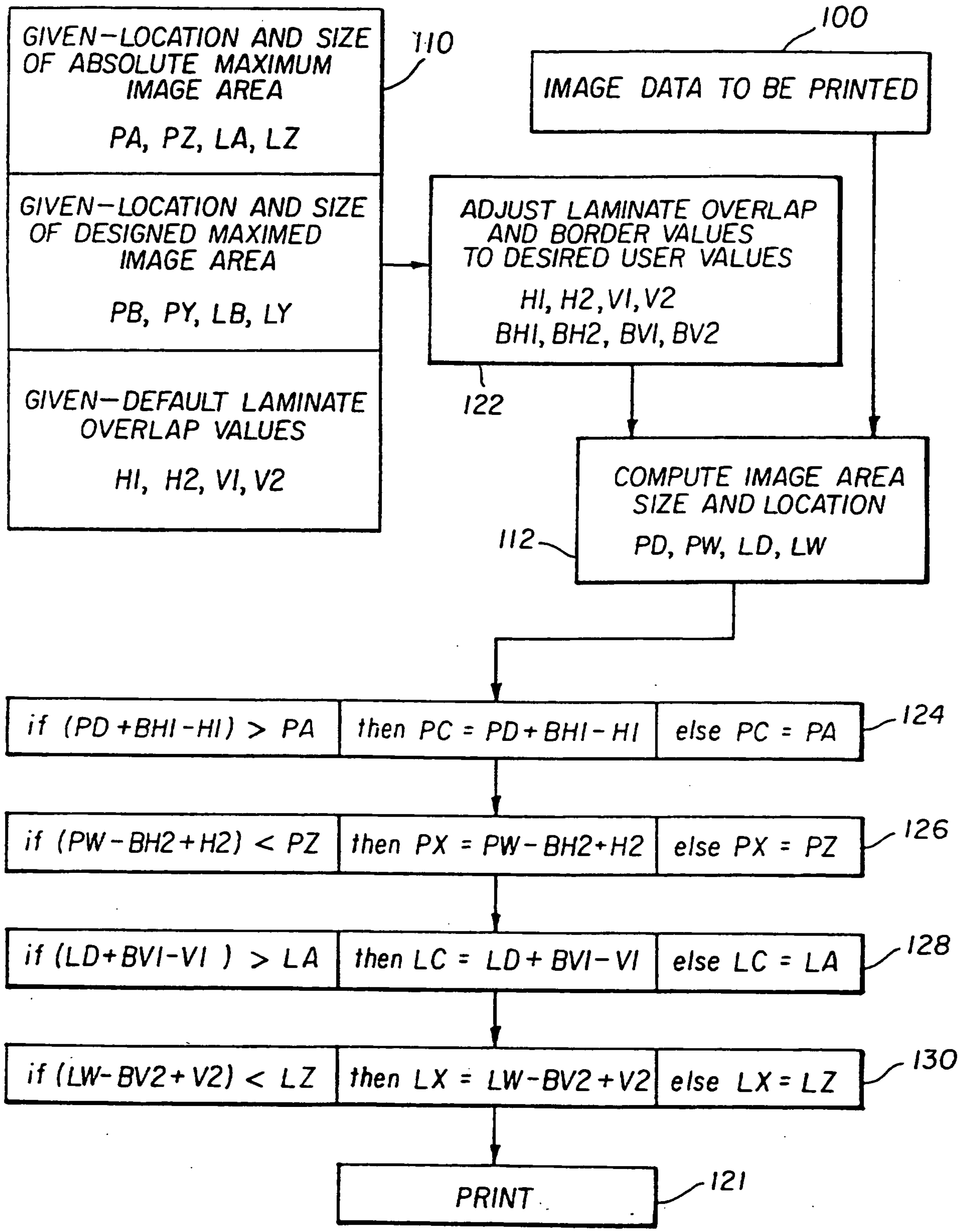

GIVEN–LOCATION AND SIZE OF ABSOLUTE MAXIMUM IMAGE AREA
PA, PZ, LA, LZ
110
GIVEN–LOCATION AND SIZE OF DESIGNED MAXIMED IMAGE AREA
PB, PY, LB, LY
GIVEN–DEFAULT LAMINATE OVERLAP VALUES
HI, H2, VI, V2
100
IMAGE DATA TO BE PRINTED
ADJUST LAMINATE OVERLAP AND BORDER VALUES TO DESIRED USER VALUES
HI, H2, VI, V2
BHI, BH2, BVI, BV2
122
COMPUTE IMAGE AREA SIZE AND LOCATION
PD, PW, LD, LW
112
if (PD + BHI - HI) > PA
then PC = PD + BHI - HI
else PC = PA
124
if (PW - BH2 + H2) < PZ
then PX = PW - BH2 + H2
else PX = PZ
126
if (LD + BVI - VI) > LA
then LC = LD + BVI - VI
else LC = LA
128
if (LW - BV2 + V2) < LZ
then LX = LW - BV2 + V2
else LX = LZ
130
PRINT
121

FIG. 20

DETERMINATION OF THE SIZE OF A LAMINATION AREA FOR A THERMAL PRINTER

Field of the Invention

The present invention relates to a thermal printer which applies a laminate material or protective layer to a print.

Background of the Invention

Color thermal printers form a color print by successively printing color information onto a dye receiver using a dye donor, where the dye donor includes a repeating series of color patches. Finished prints are susceptible to damage and degradation from handling, scratches, finger prints, fading and the like.

Prints with increased durability can be obtained by applying a protective layer, also known as a lamination layer, over the dye image of the finished print. Independent laminating devices have long been available to totally enclose a print with a protective layer. However, such devices require additional cost, space, and time on the part of the user to achieve a protected print. Further, the print can still be damaged between the time printing is completed and the time the print is laminated in a separate device.

Some thermal printers include a separate laminating station within the printer to eliminate risk of damage of the finished print prior to lamination. This extra station requires additional hardware in the printer, undesirably increasing the printer complexity and cost.

Other thermal printers apply a lamination layer at the same print station where the color information is printed on the dye receiver. For example, see U.S. Patent No. 4,738,555, which issued to M. Nagashima on April 19, 1988. In Nagashima, a

thermally-transferable laminate material that forms the protective layer is carried as a separate "patch" on a dye-donor web, and is transferred by applied heat from a print head.

While thermal printers are capable of producing visually excellent prints, they do suffer from a disadvantage in speed when compared to printers of other technologies. Therefore, extensive efforts have been made to increase the productivity of thermal printers. Now, when laminating the entire available image area, the amount of time required to laminate the print will be equivalent to the time required for the largest possible image; even if the printed image is smaller than this largest possible image size. The time period that the user must wait for a finished print includes the period while non-image area is laminated. Thus, the overall time required to produce a finished, laminated print is increased undesirably.

Another significant problem results from a difference in appearance between laminated areas and areas without lamination. Users can readily identify the edge of a laminated area, and may find it objectionable.

Still another deficiency is a potential reduction in print head life due to unnecessarily operating the print head at high energy levels.

Summary of the Invention

The present invention provides for the reduction in the time required to deliver a laminated print by efficiently laminating a minimum area to protect printed image areas, where the laminated area can be different from the entire available image area of a thermal print. According to one feature of the present invention, the laminated area can be smaller than the maximum print area; and according to another

feature of the present invention, the lamination may be larger than the maximum print area.

The present invention further provides a lamination border that is not visually apparent to a user.

The present invention still further provides an extension of the print head life due to reduced duration of high energy activation time.

According to a feature of the present invention, a printer, which is adapted to produce an image on a receiver medium within a predetermined maximum available image area of the receiver medium, includes means for transferring an area of laminate material to the receiver medium to overlie the image such that the area of laminate material transferred to the medium is different from the predetermined maximum available image area.

In one preferred embodiment of the present invention, the area of laminate material transferred to the receiver medium is larger than the size of the image and smaller than the predetermined maximum available image area.

According to another feature of the present invention, the receiver medium overlies only that portion of the receiver medium where the image has been produced.

According to still another feature of the present invention, the receiver medium overlies only that portion of the receiver medium which is enclosed by outer edges of the image that has been produced.

According to yet another feature of the present invention, the receiver medium overlies only that portion of the receiver medium which is defined by and slightly larger than the outer edges of the image that has been produced.

The invention, and its objects and advantages, will become more apparent in the detailed description of the preferred embodiments presented below.

Brief Description of the Drawings

For a better understanding of the present invention, reference will now be made, by way of example only, to the accompanying drawings in which:-

Figure 1 is a schematic of a thermal printer which can be employed to make color images in a dye receiver medium;

Figure 2 is a schematic perspective of several heating elements used in the print head of the printer of Figure 1;

Figure 3 shows a portion of a typical dye-donor web;

Figures 4a and 4b are top planar and sectional views, respectively, showing an unprotected dye image printed on a dye receiver;

Figures 5a and 5b are top planar and sectional views, respectively, showing a laminated dye image on a dye receiver, where the lamination covers all of the available image area;

Figures 6a and 6b are top planar and sectional views, respectively, showing a laminated dye image on a dye receiver, where the lamination covers only those pixels which received dye;

Figures 7a and 7b are top planar and sectional views, respectively, showing a laminated dye image on a dye receiver, where the lamination covers all areas within the image's boundaries, including pixels which received no dye;

Figures 8a and 8b are top planar and sectional views, respectively, showing a laminated dye

image on a dye receiver, where the lamination covers a rectangular area circumscribed about the image;

Figures 9a and 9b are top planar and sectional views, respectively, showing a laminated dye image on a dye receiver, where the lamination covers a rectangular area circumscribed about horizontal axis of the image, and covering the maximum available vertical image area;

Figures 10a and 10b are top planar and sectional views, respectively, showing a laminated dye image on a dye receiver, where the lamination covers a rectangular area circumscribed about the vertical axis of the image, and covering the maximum available horizontal image area;

Figures 11a and 11b are top planar and sectional views, respectively, showing a laminated dye image on a dye receiver, where the lamination covers a rectangular area which is slightly larger than the rectangle circumscribed about the image shown in Figure 8, providing overlapped lamination;

Figure 12 shows a detailed enlargement of Figure 11a, identifying horizontal and vertical overlap dimensions;

Figure 13 shows a laminated dye image on a receiver, where the lamination area is shaped like (but slightly larger than) the image, providing an irregularly shaped overlapped lamination;

Figure 14 shows the dimensions of the four major areas of a print;

Figure 15 shows a function block diagram of how the laminate area and size may be determined before the image is printed;

Figure 16 shows a function block diagram of how the laminate area and size may be determined after the image is printed;

Figure 17 shows another function block diagram of how the laminate area and size may be determined while the image is printed;

Figure 18 shows some additional function block detail on how laminate area and size may be determined;

Figure 19 shows the dimensions of the major print areas for an image data area which includes a border, so that the actual image area is smaller than the image data file area; and

Figure 20 shows additional function block detail on how laminate area and size may be determined when the image data includes a border.

Detailed Description of the Invention

The present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. It is to be understood that elements not specifically shown or described may take various forms well known to those skilled in the art. While the invention is described below in the environment of a dye-sublimation thermal printer, it will be noted that the invention can be used with other types of printers.

Referring to Figure 1, a thermal printer 210 includes a print head assembly 212 and dye-donor web supply and take-up spools 214 and 216, respectively. A main printer support structure 222 includes a roller platen assembly 218, a pair of dye receiver medium transport mechanism pinch rollers 220 and 222, and a dye receiver medium supply 224.

Normal thermal printer operations include loading dye receiver medium, printing information upon the dye receiver medium and ejecting the finished print. Each of these operations is fully described in

commonly-assigned U.S. Patent No. 5,176,458, which issued to H.G. Wirth on January 5, 1993. The disclosure of that patent is hereby incorporated into this specification by reference, and therefore only a brief description will be herein given of the illustrated embodiment of the thermal printer.

Printer operation begins with a loading phase, in which print head assembly 212 moves to a loading position. A dye-donor web 226 and a sheet 228 of dye receiver medium advance along converging paths to a printing location, and print head assembly 212 is positioned in preparation for the printing operation.

As a sheet 228 of dye receiver medium advances, it moves along a guide 230 to follow a curved path toward a gap between print head assembly 212 and platen assembly 218. As the dye receiver medium moves into this gap, it contacts dye-donor web 226 and is guided toward dye receiver medium transport mechanism pinch rollers 220 and 222.

Once dye receiver medium 228 is firmly held by dye receiver medium transport mechanism pinch rollers 220 and 222, print head assembly 212 moves toward platen assembly 218, pressing dye-donor web 226 and dye receiver medium 228 against platen assembly 218 to form a sandwich for thermal printing.

When the loading phase is completed, printer 210 enters a printing phase, during which print head assembly 212 presses dye-donor web 226 and dye receiver medium 228 into platen assembly 218, and prints information on the dye receiver medium.

Referring to Figure 2, the print head of print head assembly 212 includes a plurality of heating elements 232, such as electrical resistors, which are pressed against dye-donor web 226 to force the dye-donor web against dye receiver medium 228. When one of

a plurality of switches 234 is closed, the associated heating element 232 is connected to a voltage potential source V_S. The amount of dye transferred is a function of the time period that switch 234 is closed.

Dye-donor web 226 comprises a leader portion followed by a repeating series of dye frames. The dye frames may be contiguous as shown or spaced by inter frame regions, and, as shown in Figure 3, each series includes in sequence; yellow, magenta, and cyan dye frames. A single series is used to print one color plane on dye receiver medium 228.

In this disclosure, the term "dye" refers to a colored material which transfers from the dye-donor web to a dye receiver medium in response to energy applied by individual elements of the print head. According to the illustrated embodiment of the present invention, each of the repeating series of dye frames on dye-donor web 226 is followed by a frame coated with laminate material. The laminate material is preferably clear, and also transfers from the dye-donor web to a dye receiver medium in response to energy applied by individual elements of the print head. While the laminate material is shown carried by the dye-donor web, those skilled in the art will understand that the laminate material may be carried by a separate web and applied over the image at a lamination station downstream of the print head.

Although the print head is shown as having electrically resistive heating elements 232, those skilled in the art will understand that other sources of energy such as, diode laser array and individual lasers have been and can be effectively used to deliver energy to the print media. Further, other types of printers such as electrophotographic, ink jet, impact, etc. can be used in accordance with this invention.

After a color plane is formed on the dye receiver medium, the dye receiver medium will be referred to as a print.

As shown, there are two LEDs 236 and 238 which illuminate the dye-donor web from above. LED 236 emits green light and LED 238 emits blue light. Two photodetectors "A" and "B" are disposed below the dye-donor web and receive light which passes through the dye-donor web. Photodetectors "A" and "B" provide a signal for identifying the start of series and each individual color dye frame in such series. For a more complete discussion of this identification, reference is made to commonly assigned U.S. Patent No. 4,710,781 to S. Stephenson, the disclosure of which is incorporated by reference herein.

Thus, color thermal printers form a print by successively printing a single color onto a receiver medium, and returning the receiver medium to the beginning point; whereupon another color is printed. This process continues until all the required colors on the dye-donor web have been printed onto the receiver medium. To apply the laminate materials over the dye image, the printer repeats the above process for the additional patch of laminate material on the dye-donor web. That is, the print head is raised, and the dye-donor web is moved to the beginning of a patch of thermally-transferable laminate material. The receiver medium is repositioned such that the beginning of the image to be coated aligns with the print head. The print head is then lowered, and the lamination process begins, with the print head applying heat and pressure to the dye-donor web such that the laminate material transfers to the receiver medium.

A thermal printer typically produces a print as shown in Figure 4a, where information such as an

image 10 is formed on a dye receiver 12. The maximum available image size 14 is usually smaller than the dye receiver 12 to provide a border surrounding a finished maximum sized image; but not necessarily so. Figure 4b is a cross section of image 10 taken along line A-A of Figure 4a. It shows that a print line may have areas where transferred dye 16 forms a portion of the image as well as areas where no dye is present.

Laminate material 20 as shown in Figure 5a is commonly applied to the area of the maximum available image size 14. When this is done, a cross section of the image 10 along line A-A shows transferred dye 16 has been overlaid with transferred laminate material 20, and that transferred laminate material 20 has also been applied where no dye was transferred. The outer edge of laminate material 20 can be readily identified by a user.

One method of hiding the laminate material edge is to apply laminate material only over areas where dye has been transferred. Figure 6a shows a dotted pattern where laminate material 20 has been applied only where dye forms the image. The cross section view (Figure 6b) clearly depicts transferred laminate material 20 located only upon the transferred dye 16.

An alternative is to apply laminate material 20 to an area limited by the outer boundaries of image 10, as shown in Figures 7a and 7b. In this instance, transferred laminate material 20 is located upon areas of transferred dye 16 and on any areas not having transferred dye but which are enclosed by the outer boundaries of the image.

Another embodiment of the present invention is illustrated in the embodiment of Figures 8a and 8b, wherein laminate material 20 circumscribes a rectangle

on image 10, and wherein the edges of the rectangle are defined by the outermost edges of the image boundaries. This method may prove easier to implement than the previous embodiments.

Another method, shown in Figures 9a and 9b, could best be described as a cross between the method of Figures 8a and 8b (circumscribed rectangle on image) and the method of Figures 5a and 5b (laminate the maximum available image area). Figure 9a portrays laminating an area 20 the maximum available image size in the vertical direction but limiting the laminated area 20 in the horizontal direction to the image boundaries. The embodiment of Figures 10a and 10b is similar, but laminates an area 20 the maximum available image size in the horizontal direction while limiting the laminated area 20 in the vertical direction to the image boundaries.

The embodiments of Figures 6a to 10a require sub pixel registration accuracy between transferred laminate material 20 and transferred dye 16 to insure complete protection of the transferred dye 16. Any miss-registration will leave a portion of the dye uncovered and un-protected. When miss-registration is only slight, all but a few points of the Figure 8a image 10 will be protected when the image 10 is non-rectangular. However, most images are rectangular in form. For example, most images include a colored background rather than areas with no dye as illustrated. When there is no colored background, it is common to indicate as ``white'' any image areas that do not receive dye. Thus, the file describing the image to be printed is usually rectangular, even if the content of the image data is non-rectangular. If the lamination method using a circumscribed rectangle shown in Figure 8a were applied, a large number of points of

transferred dye 16 would not be protected at the boundaries of the laminated area 20. Both the methods shown in Figures 9a and 10a reduce registration accuracy problems in one direction, but neither protects enough of the image if the lamination is miss-registered in the other direction.

Another method for laminating an image, which decreases the risk of un-protected image portions caused by miss-registration of the laminate, is shown in Figures 11a and 11b. The laminate material is applied to a rectangular area 20 which is slightly larger than the circumscribed rectangle about the image 10. This method reduces registration accuracy problems and insures that even rectangular images are protected on all sides, as shown in the cross section of the image in Figure 11b.

Figure 12 shows an enlarged view of the embodiment of Figures 11a and 11b. Here, the image 10 is protected by a laminated area 20 which is larger than the image 10 as follows. The laminated area 20 overlaps the left-most boundary of the image 10 by a distance H1 and the right-most boundary of the image 10 by a distance H2 in the horizontal direction. Similarly, laminated area 20 overlaps the top-most boundary of the image 10 by a distance V1 and the bottom-most boundary of the image 10 by a distance V2 in the horizontal direction. The distances H1, H2, V1 and V2 may all have the same value, or they may all be different. It is even possible to have some of the distances the same while the other distances are different. In another example, the laminated area could have $H1=H2$ and $V1=V2$, but $H1\neq V1$.

Figure 13 depicts yet another lamination method in which the boundaries of the image 10 are

determined and the lamination area 20 selected to overlap the image boundaries at all points.

Figure 14 depicts a computational method which can be applied to many of the lamination methods just described. A dye receiver 12 has an absolute maximum print area 40 identified by the four points (PA, LA), (PZ, LA), (PZ, LZ), and (PA, LZ). The width of the absolute maximum print area 40 is determined by the number of active print elements on the printer's print head, and is defined as (PZ-PA). The length of the absolute maximum print area 40 is determined by the size of the dye receiver 12 and mechanical characteristics of the printer which determine the size of the print border, if any. The distance (LZ-LA) defines the length of the absolute maximum print area 40.

Printers often have a designed maximum image area 14 which can be smaller than the absolute maximum image area 40 in order to account for tolerances and alignment issues. The designed maximum image area 14 is identified by the four points (PB, LB), (PY, LB), (PY, LY) and (PB, LY). Most printers do not print outside of the designed maximum image area 14.

An image data area 42 can be located anywhere within the designed maximum image area 14, and the image data area 42 can be any size up to the designed maximum image area 14. A rectangular image may be identified by the four points (PD, LD), (PW, LD), (PW, LW) and (PD, LW). The width of the image data area 42 is defined as the distance (PW-PD), and the length of the image data area 42 is defined as the distance (LW-LD).

A non-rectangular image can be identified by a circumscribed rectangle with the same four points (PD, LD), (PW, LD), (PW, LW) and (PD, LW). In such a

instance, the top-most image pixel will be located a distance LD from the top of the dye receiver 12, and the bottom-most image pixel will be located a distance LW from the top of the dye receiver 12. The left-most image pixel would be located a distance PD from the left side of the dye receiver 12, and the right-most image pixel would be located a distance PW from the left side of the dye receiver 12. As with a rectangular image, the width of the image data area 42 is defined as (PW-PD) and the length of the image data area 42 is defined as (LW-LD).

A rectangular laminate material area 44, identified by the four points (PC, LC), (PX, LC), (PX, LX) and (PC, LX), has a width of (PX-PC) and a length of (LX-LC). The relationship of the laminate material area 44 to the other areas shown in Figure 14 is determined by which lamination method is implemented, as follows.

The lamination method shown in Figure 5a sets the laminate material area 44 of Figure 14 equal to the designed maximum image area 14. Thus, PC=PB, PX=PY, LC=LB, and LX=LY. The laminate material area 44 will overlap the image area 14 whenever the image data area 42 is smaller than the designed maximum image area 14. However, when the image data area 42 is the same size as the designed maximum image area 14, the laminate material area 44 will also be the same size as the image data area 42. This requires undesirable registration accuracy as described previously.

Some popular image data representation methods represent all images by the designed maximum image area 14. This is done by identifying all pixels which do not receive dye as "white." Thus the image data representation always includes information for every pixel.

Figure 8 shows a lamination method in which the laminate material area 44 of Figure 14 is equal to the image data area 42 and PC=PD, PX=PW, LC=LD and LX=LW. In this example, the laminate material will not overlap the dye of the image and undesirable registration accuracy is still required.

Figures 9a and 9b show a lamination method which combines portions of the methods shown in Figures 5a and 8a. In this example, the width of the laminate material area 44 of Figure 14 equals the width of the image data area 42, and the length of the laminate material area equals the length of the designed maximum image area 14. Thus, PC=PD, PX=PW, LC=LB and LX=LY. Undesirable registration accuracy is still required for the left or right edge of the laminate material area 44.

Figure 10a shows an alternate lamination method to that of Figure 9a, in which the width of the laminate material area 44 of Figure 14 equals the width of the designed maximum image area 14, and the length of the laminate material area equals the length of the image data area 42. Thus PC=PB, PX=PY, LC=LD and LX=LW. Undesirable registration accuracy is still required for the top or bottom edge of the laminate material area 44.

Figures 11a and 12a show a lamination method in which the laminate material area 44 of Figure 14 is larger than image data area 42. In this example, the top-most edge of the laminate material area 44 overlaps the top-most edge of the image data area 42 by a distance V1=LD-LC. The bottom-most edge of the laminate material area 44 overlaps the bottom-most edge of the image data area 42 by a distance V2=LX-LW. Similarly, the left-most edge of the laminate material area 44 overlaps the left-most edge of the image data

area 42 by a distance H1=PD-PC and the right-most edge of the laminate material area 44 overlaps the right-most edge of the image data area 42 by a distance H2=PX-PW.

When the image data area 42 is small enough and positioned appropriately, the laminate material area 44 will be within the designed maximum image area 14. However, if the image area 44 is located close to or at a border of the designed maximum image area 14, the laminate material area 44 would extend beyond the borders of the designed maximum image area 14. This situation occurs when (LD-LB<V1) or (LY-LW<V2) or (PD-PB<H1) or (PY-PW<H2). Should this happen, it is possible to obtain some or all of the desired overlap of laminate material area 44 to image data area 42 by activating normally unused pixels located outside of the designed maximum image area 14. Thus, even if the image data area 42 was the same size as the designed maximum image area 14, the laminate material area 44 could still overlap the image data area 42 by a minimum amount. The minimum amount of overlap of the laminate material area 44 to the image data area 42 would be PB-PA on the left-most edge, PZ-PY on the right-most edge, LB-LA on the top-most edge and LZ-LY on the bottom-most edge. These values represent the minimum overlap of the laminate material area 44 to the image data area 42 which the printer could provide, and these values may also be less than the default values for H1, H2, V1, or V2.

Figure 15 shows one sequence of function blocks for printing an image and laminate. In this example, the image data 100 which is to be printed is evaluated by the printer to compute the image boundaries (step 102). The printer next computes the laminate material boundaries (step 104) from the image

boundaries. The printer next prints the image (step 106), and then prints the laminate material over the image (step 108).

Figure 16 portrays an alternate function block sequence to that shown in Figure 15. As before, the image data 100 which is to be printed is evaluated by the printer to compute the image boundaries (step 102) after which the image data is printed (step 106). The printer next determines the laminate material boundaries (step 104) and then the printer prints the laminate material (step 108).

It is also possible, as shown in Figure 17, for the printer to compute the image boundaries (step 102) and determine the laminate material boundaries (step 104) at the same time the printer is printing the image (step 106).

Figure 18 provides a few additional details for one embodiment of function blocks 102 and 104 in Figures 15-17. Several pieces of information 110 are available to the printer by design, programming, default values or other means such as user defined variables or media type identifiers. This information includes the location and size of the absolute maximum image area 40, which provides the values PA, PZ, and LA. The type of dye receiver 12 which is in the printer determines the value LZ. The location and size of the designed maximum image area is given by values PB, PY, and LB, while the value LY can be determined from the type of dye receiver 12 similarly to the value for LZ. Default values H1, H2, V1, and V2 for laminate material area 44 overlap of image data area 42 can be stored in the printer or provided by other means.

Computation of image area size and location (step 112) based on image data 100 and information 110 produces values PD, PW, LD, and LW.

These values are then used to determine size and location of laminate material area 44. Function block 114 sets the left-most laminate material boundary PC equal to PD-H1 if PD-H1>PA, otherwise function block 114 sets PC equal to PA. Function block 116 sets the right-most laminate material boundary PX equal to PW+H2 if PW+H2<PZ, otherwise function block 116 sets PX equal to PZ. Similarly, function block 118 sets the top-most laminate material boundary LC equal to LD-V1 if LD-V1>LA, otherwise function block 118 sets LC equal to LA; and function block 120 sets the bottom-most laminate material boundary LX equal to LW+V2 if LW+V2<LZ, otherwise function block 120 sets LX equal to LZ. Printing (step 121) then proceeds.

The amount of laminate material area 44 overlap of the image data area 42 can vary from zero to a maximum value as shown in Table 1. For example, the overlap of the left-most side of laminate material area 44 to image data area 42 can have a maximum value of PD-PA (Figure 14), and the default value is H1. Similarly, the overlap of the right-most side of laminate material area 44 to image data area 42 can have a maximum value of PZ-PW and the default value is H2; the overlap of the top-most side of laminate material area 44 to image data area 42 can have a maximum value of LD-LA with a default value of V1; and the overlap of the bottom-most side of laminate material area 44 to image data area 42 can have a maximum value of LZ-LW with a default value of V2. Note that positive values for H1, H2, V1, and V2 indicate the laminate material area 44 overlaps the image data area 42, while zero values indicate no overlap of these areas.

Table 1

LAMINATE OVERLAP OF IMAGE	MAXIMUM OVERLAP VALUE	DEFAULT OVERLAP VALUE	MINIMUM OVERLAP VALUE
left-most side	PD-PA	H1	0
right-most side	PZ-PW	H2	0
top-most side	LD-LA	V1	0
bottom-most side	LZ-LW	V2	0

Sometimes the image data received for printing already includes borders where no dye is transferred to the dye receiver. Application of the methods shown in Figures 14 and 18, for example, would locate the edge of the laminated area the distance of the border from the actual image area. This would produce a print with a readily visible laminate material area edge, which is undesirable. The following method permits any image data, even image data with borders, to be laminated such that the edge of the laminate material is not visually apparent to the user.

Figure 19 depicts a modified computational method which can be applied to many lamination methods which receive image data that includes a border. A dye receiver 12 has, but does not show, an absolute maximum print area and a designed maximum image area.

An image data area 42 located within the designed maximum image area is identified by the four points (PD, LD), (PW, LD), (PW, LW) and (PD, LW). In this example, the image data area 42 includes an image area 46 identified by the four points (PE, LE), (PV, LE), (PV, LV), and (PE, LV). The image area 46 may be located anywhere within the image data area 42.

When the image area 46 is the same size as the image data area 42, then PE=PD, PV=PW, LE=LD, and

LV=LW. When this is true, the lamination methods of Figures 14 and 18 provide a desirable laminated print.

When the image data area 42 includes a border, then at least one of the following is true: PE≠PD or PV≠PW or LE≠LD or LV≠LW. When a border is present in the image data area 42, it is desirable to provide the appropriate overlap of the laminate material area 44 to the image area 46. To achieve this, the definition of laminate material area 44 must be modified as follows. A rectangular laminate material area 44 is identified by four points (PCB, LCB), (PXB, LCB), (PXB, LXB), and (PCB, LXB). This laminate material area 44 has a width of PXB-PCB and a length of LXB-LCB. The relationship of the laminate material area 44 to the other areas shown in Figure 19 is determined by the border and image area 46. In this example, a border is shown between the image data area 42 and the image area 46 on all sides.

The image data area 42 is larger than the left-most boundary of the image area 46 by a distance BH1 where BH1=PE-PD. The image data area 42 is also larger than the right-most boundary of image area 46 by a distance BH2, where BH2=PW-PV. Similarly, image data area 42 is larger than the top-most boundary of image area 46 by a distance BV1=LE-LD and the bottom-most boundary of image area 42 by a distance BV2=LW-LV. The distances BH1, BH2, BV1, and BV2 may all have the same value, or they may all be different. It is possible to have some of the distances the same while other distances are different. In another example, the image data area could have BH1=BH2 and BV1=BV2, but BH1≠BV1. When BH1=BH2=BV1=BV2=zero, the image area 46 is the same size as the image data area 42, allowing the use

of the lamination methods of Figures 14 and 18 to achieve a desirable laminated print.

In Figure 19, a border exists on all four sides of the image data area 42. To locate the laminate material area 44 such that the edge of the laminate material is not visually apparent to the user, the following modified computations are made. The top-most edge of the laminate material area 44 overlaps the top-most edge of the image area 46 by a distance V1=LE-LCB. The bottom-most edge of the laminate material area 44 overlaps the bottom-most edge of the image area 46 by a distance V2=LXB-LV. Similarly, the left-most edge of the laminate material area 44 overlaps the left-most edge of the image area 46 by a distance H1=PE-PCB and the right-most edge of the laminate material area 44 overlaps the right-most edge of the image area 46 by a distance H2=PXB-PV.

Figure 19 also shows that PE=(PD+BH1), PV=(PW-BH2), LE=(LD+BV1), and LV=(LW-BV2). Substituting these equations with those in the preceding paragraph produces the following rearranged equations:

- PCB = PD + BH1 - H1 (equation 1)
- PXB = PW - BH2 + H2 (equation 2)
- LCB = LD + BV1 - V1 (equation 3)
- LXB = LW - BV2 + V2 (equation 4)

It can be shown that when no borders are present, PCB=PC, PXB=PX, LCB=LC, and LXB=LX. Simplifying the above equations with these equalities provides the final equations for this method:

- PC = PD + BH1 - H1 (equation 5)
- PX = PW - BH2 + H2 (equation 6)
- LC = LD + BV1 - V1 (equation 7)
- LX = LW - BV2 + V2 (equation 8)

When the distances BH1, BH2, BV1, and BV2 are zero, the edges of the laminate material area 44 are located outside of image data area 42. Conversely, when distances BH1, BH2, BV1, and BV2 are not zero, the edges of the laminate material area 44 may be located inside image data area 42.

Figure 20 details an embodiment of the equations just described for an image data area which can include a border. Several pieces of information 110 are available to the printer by design, programming, default values or other means such as user-defined variables or media-type identifiers. This information includes the location and size of the absolute maximum image area 40, which provides the values PA, PZ, and LA. The type of dye receiver 12 which is in the printer determines the value LZ. The location and size of the designed maximum image area is given by values PB, PY, and LB, while the value LY can be determined from the type of dye receiver 12 similarly to the value for LZ. Default values H1, H2, V1, and V2 for laminate material area 44 overlap of image data area 42 can be stored in the printer or provided by other means. In addition, default border values BH1, BH2, BV1, and BV2 can be stored in the printer or they can be provided by other means.

In this example, the printer may adjust or modify the default values for laminate material overlap (H1, H2, V1, and V2) and/or the default values for border sizes (BH1, BH2, BV1, and BV2) as illustrated by function block 122. These value adjustments may be obtained from a variety of means well known to those skilled in the art, such as computations or user-provided alternative values which accompany the image data.

Computation of image area size and location 112 is now based on image data 100 and information 110 and 122. This produces values PD, PW, LD, and LW. These values are then used to determine size and location of laminate material area 44. Function block 124 sets the left-most laminate material boundary PC equal to (PD+BH1-H1) if (PD+BH1-H1)>PA, otherwise function block 124 sets PC equal to PA. Function block 126 sets the right-most laminate material boundary PX equal to (PW-BH2+H2) if (PW-BH2+H2)<PZ, otherwise function block 126 sets PX equal to PZ. Similarly, function block 128 sets the top-most laminate material boundary LC equal to (LD+BV1-V1) if (LD+BV1-V1)>LA, otherwise function block 128 sets LC equal to LA; and function block 130 sets the bottom-most laminate material boundary LX equal to (LW-BV2+V2) if (LW-BV2+V2)<LZ, otherwise function block 130 sets LX equal to LZ. Printing then proceeds (step 121).

The amount of laminate material area 44 overlap of the image area 46 can vary from zero to a maximum value as shown in Table 1. Positive values for H1, H2, V1, and V2 indicate the laminate material area 44 overlaps the image data area 42, while zero values indicate no overlap of these areas.

Table 2 presents default overlap values and default border values for this method. Also shown are the maximum which any border value can attain. These maximum border values can be used to verify range limits during computations.

Table 2

LAMINATE OVERLAP OF IMAGE	DEFAULT OVERLAP VALUE	DEFAULT BORDER VALUE	MAXIMUM BORDER VALUE
left-most side	H1	BH1=0	0.5*[(PW-BH2)-(PD+BH1)]-PA
right-most side	H2	BH2=0	PZ-0.5*[(PW-BH2)-(PD+BH1)]
top-most side	V1	BV1=0	0.5*[(LW-BV2)-(LD+BV1)]-LA
bottom-most side	V2	BV2=0	LZ-0.5*[(LW-BV2)-(LD+BV1)]

The values for H1, H2, V1, and V2, the amount of laminate material area 44 overlap of the image data area 42 (or of the image area 46 in the case of image data including borders), are selected to provide a laminated edge that is not visually apparent to the user. Although these overlap values can range from zero to the values shown in Table 1, it is desirable to have as small a value possible while still providing acceptable registration accuracy. In one example, the values of H1=H2=3 pixels and V1=V2=6 pixels provide acceptable prints.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

CLAIMS:

1. A printer (210) for producing an image on a receiver medium (228) from a file source of image data, said printer having means for transferring an area of laminate material (20) to the receiver medium to overlie the image, characterized by the area of laminate material transferred to the receiver medium being determined by the image data from the file source.

The Patent Office

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Application No: GB 9724434.7
Claims searched: 1

Examiner: Gary Williams
Date of search: 14 January 1998

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B6F:FBH

Int Cl (Ed.6): B41J: 2/325; B41M: 7/00

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
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